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(54) Title: AN IMPLEMENT FOR DETECTING PHYSICAL ABNORMALITIES IN MILK

(57) Abstract: An implement for detecting physical abnormalities in milk, which implement is provided with a light source for irradiating milk with light of a red and/or a green and/or a blue colour. The intensity of light reflected and/or diffused and/or transmitted by the milk and/or background light is measured by means of light sensors. A computer processes the measurement data. The computer is programmed to select, on the basis of a comparison of values derived from the measured light intensities with reference values, one or more diagnoses for the abnormalities in the milk from a plurality of diagnosis possibilities stored.

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## Family

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|--------------------|----------------|----------------|---|
| WO0156369A1        | Aug. 9, 2001   | Jan. 9, 2001   | AN IMPLEMENT FOR DETECTING PHYSICAL ABNORMALITIES IN MILK       |
| US20020054831A1    | May 9, 2002    | Sept. 28, 2001 | Implement for detecting physical abnormalities in milk          |
| NZ0514125A         | Sept. 28, 2001 | Jan. 9, 2001   | AN IMPLEMENT FOR DETECTING PHYSICAL ABNORMALITIES IN MILK       |
| NL1014260C2        | Aug. 3, 2001   |                |   |
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| <b>EP1164832A1</b> | Jan. 2, 2002   | Jan. 9, 2001   | AN IMPLEMENT FOR DETECTING PHYSICAL ABNORMALITIES IN MILK       |
| AU0132478A5        | Aug. 14, 2001  | Jan. 9, 2001   | AN IMPLEMENT FOR DETECTING PHYSICAL ABNORMALITIES IN MILK       |

## AN IMPLEMENT FOR DETECTING PHYSICAL ABNORMALITIES IN MILK

The invention relates to an implement for detecting physical abnormalities in milk according to the preamble of claim 1. The invention further relates to a milking robot  
5 which is provided with the implement.

Such an implement is known from patent application NL-1004980. The presence of particular substances in the milk can be detected by means of the known colour sensor measuring  
10 system. A disadvantage thereof is that a user often has to make himself a further analysis of the milk condition on the basis of the detected substances. Moreover, the results are not very reliable.

The invention aims at further developing and  
15 improving such an implement. According to the invention, this is achieved by the measures described in the characterizing part of claim 1.

The values derived from the measured light intensities may be said measured values themselves, but  
20 preferably values corrected by means of the computer are determined and used. For that purpose the computer is programmed to determine corrected values as said values derived from the measured light intensities, the correction compensating the influence of the temperature of the light  
25 source and/or of the milk on the measured intensities. The fact is that particularly the temperature of the light source, such as e.g. a LED, has proved to influence the measured values of the intensities. The measured values may be converted by the computer to measured values related to a  
30 temperature of e.g. 25°C.

The computer may further be programmed to determine corrected values as said values derived from the measured light intensities, the correction compensating the differences  
35 between the light sensors used. The fact is that different specimens of the light sensor may have mutually differing measuring characteristics. By means of the correction undesired temperature influences and/or differences between

the sensors used are thus compensated. In this manner the reliability of the implement is enhanced.

As reference values may be used fixed values (e.g. of reference milk). However, preferably dynamic values are used, such as e.g. average values over the last milkings of a group of animals. Preferably the computer avails of information in relation to the identity of the animals from which the analysed milk has been yielded. The diagnosis possibilities stored comprise syndromes for the animal from which the relevant milk has been yielded, milk quality indications and the presence of particular substances in the milk.

The invention will be explained hereinafter in further detail with reference to some examples.

The implement is further provided with a display unit, the computer being suitable for displaying via said display unit measurement data and/or results of processed measurement data and/or selected diagnosis/diagnoses. In this manner the implement is user-friendly.

The implement may further be provided with means for measuring the conductivity of the milk and/or milk samples, the computer being suitable for comparing values derived from the measured values of the conductivity with further reference values. The derived values may again be the result of a correction or conversion carried out with the aid of the computer. The further reference values are again fixed or dynamic values. By combining the measurement data of the light intensity with the measurement data of the conductivity, there can be achieved a high degree of reliability upon selection of the diagnosis/diagnoses.

The implement is preferably designed as a quadruple implement for carrying out measurements per udder quarter with cows.

The computer is programmed to select the diagnosis "mastitis; pathogen: E-coli" for an udder quarter upon detection by the light sensors of a decreased intensity of diffused light of a blue as well as a green as well as a red colour for the relevant udder quarter relative to the

reference values. When the measured intensity of the diffused light or the value derived therefrom by the computer for blue as well as green as well as red light is at least 10% lower than the reference value, then the computer selects the  
5 diagnosis that the udder quarter related to the relevant milk is affected by mastitis caused by E-coli bacteria.

It has been found that upon measurements on colostrum the intensity of diffused blue light is lower than normally. The computer is programmed to select the diagnosis "colostrum"  
10 upon detection by the light sensors of a decreased intensity of diffused light of a blue colour for all the udder quarters relative to the reference values.

When for an udder quarter the intensity of diffused blue light is lower than normally, then we are dealing with  
15 mastitis. The computer is programmed to select the diagnosis "mastitis" for an udder quarter upon detection by the light sensors of a decreased intensity of diffused light of a blue colour for the relevant udder quarter relative to the reference values.

20 At a decreased intensity of diffused blue light combined with a somewhat less decreased intensity of diffused green light it is very likely that we are dealing with mastitis. Therefore the computer is programmed to select the diagnosis "mastitis" for an udder quarter upon detection by  
25 the light sensors of a decreased intensity of diffused light of a blue colour for the relevant udder quarter relative to the reference values and a less decreased intensity of diffused light of a green colour for the relevant udder quarter relative to the reference values.

30 The computer is further programmed to select the diagnosis "mastitis" for an udder quarter upon detection by the light sensors of a decreased intensity of diffused light of a blue colour for the relevant udder quarter relative to the reference values in combination with detection of an  
35 increased conductivity for the relevant udder relative to the further reference values. Also this combination of measured values indicates mastitis.

The computer is programmed to select additionally the diagnosis "pathogen: SAU (staphylococcus aureus)" for an udder quarter upon detection by the light sensors of an also slightly decreased intensity of diffused light of a red colour for the relevant udder quarter relative to the reference values. The computer is programmed to select additionally the diagnosis "pathogen: E-coli" for an udder quarter upon detection by the light sensors of an also strongly decreased intensity of diffused light of a red colour for the relevant udder quarter relative to the reference values. In this manner the implement provides a more detailed diagnosis for the abnormalities in the milk.

The computer may further be programmed to select the diagnosis "blood" for an udder quarter upon detection by the light sensors of a decreased intensity of diffused light of both a green and a blue colour for the relevant udder quarter relative to the reference values.

The computer is programmed to select the diagnosis "blood" for an udder quarter upon detection by the light sensors of a decreased intensity of diffused light of both a green and a blue colour for the relevant udder quarter relative to the reference values in combination with detection of a hardly deviating conductivity for the relevant udder quarter relative to the further reference values. The combination of said measured values has proved to provide a reliable diagnosis.

The computer may also be programmed to select the diagnosis "mastitis; pathogen: E-coli" for an udder quarter upon detection by the light sensors of an increased intensity of transmitted light of a green as well as a blue as well as a red colour for the relevant udder quarter relative to the reference values. The increased transmission values also indicate an udder inflammation by E-coli bacteria.

The computer is preferably programmed to select and perform one or more actions to be carried out on the basis of the selected diagnosis/diagnoses from a plurality of action possibilities stored. The action possibilities stored comprise

e.g. reporting somehow the number of the relevant animal. Upon detection of a particular syndrome, for example, the computer may put the number of the relevant animal on an attention list or on a separation list in the computer, so that the required  
5 further steps can be taken.

The computer may also be connectable to further equipment and then be programmed to select one or more actions to be carried out on the basis of the selected diagnosis/diagnoses from a plurality of action possibilities  
10 stored. In that case the computer is suitable for actuating said further equipment in such a manner that the further equipment performs the selected actions. The computer may be connected, for example, to an automatic feeding device. In case of a particular diagnosis the computer sends a control  
15 signal to the feeding device, on the basis of which the composition of the feed for the relevant animal is adapted. By means of a control signal the computer can also select and/or supply particular medicines with the aid of a metering device.

The implement described is extremely suitable for  
20 being used with a milking robot. Abnormalities in the milk can be detected quickly, efficiently and reliably by means of the implement. The actions required can, at least partially, be carried out automatically by means of the implement described.

## CLAIMS

1. An implement for detecting physical abnormalities in milk, which implement is provided with at least one light source for irradiating milk and/or milk samples with light of a red and/or a green and/or a blue colour, and at least one light sensor for measuring the intensity of light reflected and/or diffused and/or transmitted by the milk and/or background light, as well as a computer for processing measurement data, characterized in that the computer is programmed to select one or more diagnoses for the abnormalities in the milk from a plurality of diagnosis possibilities stored, on the basis of a comparison of values derived from the measured light intensities with reference values.
2. An implement as claimed in claim 1, characterized in that the computer is programmed to determine corrected values as said values derived from the measured light intensities, the correction compensating the influence of the temperature of the light source and/or of the milk on the measured intensities.
3. An implement as claimed in claim 1 or 2, characterized in that the computer is programmed to determine corrected values as said values derived from the measured light intensities, the correction compensating the differences between the light sensors used.
4. An implement as claimed in any one of claims 1 to 3, characterized in that the implement is further provided with a display unit, the computer being suitable for displaying via said display unit measurement data and/or results of processed measurement data and/or selected diagnosis/diagnoses.
5. An implement as claimed in any one of claims 1 to 4, characterized in that the implement is further provided with means for measuring the conductivity of the milk and/or milk samples, and in that the computer is suitable for comparing values derived from the measured values of the conductivity with further reference values.



6. An implement as claimed in any one of claims 1 to 5, characterized in that the implement is designed as a quadruple implement for carrying out measurements per udder quarter.

7. An implement as claimed in any one of claims 1 to 6,  
5 characterized in that the computer is programmed to select the diagnosis "colostrum" upon detection by the light sensors of a decreased intensity of diffused light of a blue colour for all the udder quarters relative to the reference values.

8. An implement as claimed in any one of claims 1 to 6,  
10 characterized in that the computer is programmed to select the diagnosis "mastitis" for an udder quarter upon detection by the light sensors of a decreased intensity of diffused light of a blue colour for the relevant udder quarter relative to the reference values.

9. An implement as claimed in any one of claims 1 to 6,  
15 characterized in that the computer is programmed to select the diagnosis "mastitis" for an udder quarter upon detection by the light sensors of a decreased intensity of diffused light of a blue colour for the relevant udder quarter relative to  
20 the reference values and a less decreased intensity of diffused light of a green colour for the relevant udder quarter relative to the reference values.

10. An implement as claimed in any one of claims 5 and 6,  
25 characterized in that the computer is programmed to select the diagnosis "mastitis" for an udder quarter upon detection by the light sensors of a decreased intensity of diffused light of a blue colour for the relevant udder quarter relative to the reference values in combination with detection of an increased conductivity for the relevant udder quarter relative  
30 to the further reference values.

11. An implement as claimed in any one of claims 8 to 10,  
characterized in that the computer is programmed to select additionally the diagnosis "pathogen: SAU (staphylococcus aureus)" for an udder quarter upon detection by the light  
35 sensors of an also slightly decreased intensity of diffused light of a red colour for the relevant udder quarter relative to the reference values.

12. An implement as claimed in any one of claims 8 to 10, characterized in that the computer is programmed to select additionally the diagnosis "pathogen: E-coli" for an udder quarter upon detection by the light sensors of an also  
5 strongly decreased intensity of diffused light of a red colour for the relevant udder quarter relative to the reference values.

13. An implement as claimed in any one of claims 1 to 6, characterized in that the computer is programmed to select the  
10 diagnosis "blood" for an udder quarter upon detection by the light sensors of a decreased intensity of diffused light of both a green and a blue colour for the relevant udder quarter relative to the reference values.

14. An implement as claimed in any one of claims 1 to 6, characterized in that the computer is programmed to select the  
15 diagnosis "blood" for an udder quarter upon detection by the light sensors of a decreased intensity of diffused light of both a green and a blue colour for the relevant udder quarter relative to the reference values, combined with detection of a  
20 hardly deviating conductivity for the relevant udder quarter relative to the further reference values.

15. An implement as claimed in any one of claims 1 to 6, characterized in that the computer is programmed to select the diagnosis "mastitis; pathogen: E-coli" for an udder quarter  
25 upon detection by the light sensors of an increased intensity of transmitted light of a green as well as a blue as well as a red colour for the relevant udder quarter relative to the reference values.

16. An implement as claimed in any one of claims 1 to 6, characterized in that the computer is programmed to select the  
30 diagnosis "mastitis; pathogen: E-coli" for an udder quarter upon detection by the light sensors of a decreased intensity of diffused light of a blue as well as a green as well as a red colour for the relevant udder quarter relative to the  
35 reference values.

17. An implement as claimed in any one of claims 1 to 16, characterized in that the computer is programmed to select and

perform one or more actions to be carried out on the basis of the selected diagnosis/diagnoses from a plurality of action possibilities stored.

18. An implement as claimed in any one of claims 1 to 17,  
5 characterized in that the computer is programmed to select one or more actions to be carried out on the basis of the selected diagnosis/diagnoses from a plurality of action possibilities stored and is capable of being connected to further equipment and suitable for actuating said further equipment in such a  
10 manner that it performs the selected actions.

19. A milking robot provided with an implement as claimed in any one of claims 1 to 18.

# INTERNATIONAL SEARCH REPORT

Inter. Appl. No.  
PCT/NL 01/00011

A. CLASSIFICATION OF SUBJECT MATTER  
IPC 7 A01J5/013 A01J5/00

According to International Patent Classification (IPC) or to both national classification and IPC

## B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)  
IPC 7 A01J

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal, WPI Data, PAJ

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

| Category * | Citation of document, with indication, where appropriate, of the relevant passages                       | Relevant to claim No. |
|------------|--|-----------------------|
| A          | NL 1 004 980 C (MAASLAND NV)<br>15 July 1998 (1998-07-15)<br>cited in the application<br>claims; figures | 1-19                  |
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☐ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

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Information on patent family members

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| Patent document<br>cited in search report | Publication<br>date | Patent family<br>member(s) | Publication<br>date |
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